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SANITARY PROBLEMS CONNECTED WITH THE CONSTRUCTION OF THE ISTHMIAN CANAL.

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Now that it has been definitely decided that the United States will construct an interoceanic ship-canal across the isthmus, it is well to give careful consideration to all the problems connected with this stupendous undertaking.

The engineering problems have been fully considered, and we have the assurance that a canal can be constructed, either by the Nicaragua or the Panama route.

It now seems almost certain that the United States will secure a satisfactory title to the property and concessions of the Panama Canal Company, and that the canal will be constructed upon this line. The financial problem is solved by the fact that the United States Government is fully committed to the undertaking, and whether the estimates submitted to Congress are adequate or otherwise, the final result is assured. A hundred millions, more or less, for a country which is spending from eight hundred millions to a billion dollars, annually, is a small matter, when we consider the magnitude of the enterprise, and the important advantages to the United States and to the world which will result from the completion of this interoceanic water-way.

But, while this is true, it is also true that, aside from the question of cost, the difficulties attending the enterprise and the time required to accomplish the task will depend largely upon conditions of a different order, which are too frequently ignored by engineers and financiers.

I have not the data at hand to enable me to state how many laborers and officials lost their lives during the progress of the work on the Panama Canal, but it is generally known that the number was enormous, and that the insanitary conditions along the line of the canal, and the consequent sickness and mortality among the employees of the Canal Company, constituted one of the most serious difficulties with which this company had to contend.

The object of the present paper is to indicate how these difficulties may be avoided in future, and to impress upon those who will have charge of the work the fact that, in the present state of sanitary science, it would not only be costly, but criminal, to repeat the experiences of the past in this regard. From a humanitarian point of view, it will readily be conceded that an unnecessary sacrifice of the lives of those who are employed to do the work of excavating the canal, would be unjustifiable; but it is not to be expected that an undertaking of this kind will be postponed or delayed on account of the possibility that large numbers of human lives may be sacrificed in carrying out plans which have been made by expert engineers, and approved by the Congress of the United States.

The laborers and those who superintend their work will be very much in the position of soldiers who are sent to a distant and unhealthy country to promote the interests of their Government. They go without question or complaint; and if they fall victims to some infectious disease or to the bullet of the enemy, their places are promptly filled by others who willingly submit themselves to the same chances. But it is evident that, aside from the humanitarian point of view, the better they are trained for the service required of them—whether soldiers or laborers—the more difficult it will be to replace them, and the greater the financial loss when they are prevented by sickness from performing the special duties required of them. A Jamaica negro, who is employed simply to handle a pick or a shovel, may be easily replaced; but when an engineer who has charge of a steam shovel falls sick, the expensive apparatus which he has been trained to control may lie idle.

As great engineering enterprises now depend largely upon the employment of skilled labor, it is evident that the preservation of the health of these laborers is an economic question of prime importance. From our point of view, it is so important that it is incumbent upon the government which undertakes to construct an isthmian canal to give to those who will be engaged in the actual prosecution of the work all the advantages to be derived from a well-organized sanitary service, based upon the present state of scientific information relating to the cause and prevention of those infectious diseases which are most likely to prevail under the conditions which will exist along the line of the proposed canal. We know what these diseases are; we know the conditions which lead to their epidemic prevalence; and we know how to prevent them. Under these circumstances, it would indeed be criminal not to apply this knowledge in a practical way for the preservation of the lives of those who are called upon to battle with those malign agents which appear to oppose themselves to man, in his efforts to overcome the barriers raised by nature to arrest his progress in the subjection of the earth to his material uses. In this battle the soldier of labor is supported by enormous and complicated engines of war, operated by steam, by electricity, or by explosives which rend the solid rock.

But when these are in position and the tearing down of a mountain has been fairly commenced, all his efforts may be paralyzed, and his steam shovels and diamond drills compelled to remain idle, because of the attacks of an unseen foe, such as the bacillus of typhoid fever, the parasite of malarial fever, or the unrecognized germ of yellow fever.

The laborers upon the isthmian canal will be exposed to the ravages of all these infectious diseases; and it may be confidently asserted that each one of them will claim numerous victims, unless the proper measures of protection are enforced. It is well known that the prevalence of typhoid fever depends, to a large extent, upon the quality of the water supply, and that, when there is any possibility that this may be contaminated, the simple and obvious method of prevention is to sterilize all drinking-water. This is best accomplished by heat; but it is not sufficient to give directions that all water used for drinking must be boiled. There must be some one to see that a sufficient supply of sterilized water, properly cooled, is always available, and that none other is used. We cannot depend upon precept alone, when it is a question of protecting soldiers or laborers from the invisible foes which surround them. They are accustomed to judging of the purity of water by its taste and appearance, and to drinking any water at hand when they are thirsty.

The question of water supply must therefore not be left to individual judgment. No doubt, it will usually be practicable to bring an ample supply of pure water in pipes, from springs or mountain streams, to the places along the line of the canal where it is needed, and this will be best and cheapest in the long run. But it will not do to trust to sub-contractors to do this, or to carry out other necessary sanitary measures. It should be one of the principal functions of the general sanitary service, under government control, to provide a pure water supply for the entire line of the canal, and it should be expected that considerable sums of money will be required for this important work. A pure water supply should be insured before laborers are sent to any particular section of the line to commence work; and, at the same time, provision should be made for the safe disposition of human excreta, either by sewers, cremation or burial in deep pits properly located and systematically disinfected. The disastrous effects of a failure to do this are illustrated by the prevalence of typhoid fever in nearly all of our improvised camps during the earlier months of the Spanish-American war.

I had pointed out in a circular dated April 25th, 1898, the dangers to be apprehended and the proper means of prevention; but the officers and enlisted men of our hastily assembled volunteer army paid little attention to these admonitions, and the Surgeon-General of the army has no power for the enforcement of sanitary regulations. If we are again called upon to assemble hastily a large array of undisciplined troops, we may expect a repetition of our unfortunate experiences, unless we provide in advance for suitable camping grounds, supplied with an abundance of pure water, and with necessary facilities for the prompt and safe disposal of excreta.

In my paper on "Sanitary Lessons of the War," read at the meeting of the American Medical Association at Columbus, Ohio, June 6th, 1899, I called attention to this matter, and insisted upon the importance of providing such camping grounds in which to assemble our troops, in case another similar emergency should arise. In this paper I said:

> "Want of discipline and experience on the part of officers and enlisted men, together with the apparent emergency which caused them to be brought together in large camps in great haste, and before proper preparation could be made for their reception and the supply of their many wants, were the fundamental and, to a large extent, unavoidable

causes of the extension of typhoid fever in our camps. But the first step in the development of an epidemic of an infectious disease is the introduction of the specific germ to which it is due. Unfortunately, typhoid fever is endemic in nearly all parts of the United States; and, when a thousand men are brought together from any section, there is a fair chance that one or more of them are already infected with this disease. Unless these cases are recognized at the very outset the camp site is liable to be contaminated by typhoid excreta, and the bacilli, through the agency of flies, or in a desiccated condition carried by the wind, effect a lodgement upon food being prepared in the company kitchens, and thus find their way to the alimentary tract of susceptible individuals.

"The attention of the profession has been largely attracted to the propagation of this disease through contamination of the water supply and to the distribution of typhoid bacilli by the milkman, and there has perhaps been a tendency to overlook other modes of infection, which, in the absence of sewers and under conditions such as existed in our camps during the first months of the war with Spain, were even more important. It is evident that one or two unrecognized cases might be sufficient to inaugurate an epidemic in a regimental camp which has been occupied for a period of a month or more. In many cases, it was brought to our large camps from the State camps where the regiments were mustered into service. . . .

"The value of the aphorism, 'In time of peace prepare for war,' has received additional support. This preparation should include a corps of trained medical officers larger than is absolutely necessary for the army on a peace basis, and systematic instruction in military medicine and hygiene for the medical officers of the National Guard, as well as for those of the Regular Army; also instruction of line-officers in the elements of hygiene, and especially in camp sanitation. It should also include the establishment of camping grounds in various parts of the country, having an ample supply of pure water, a proper system of sewers, etc. If our volunteers could have been assembled in such camps during the late war, a saving in lives and money would have resulted, which would, without doubt, have demonstrated the economy of such a preparation for war in time of peace."

The conditions under which laborers must live, while engaged in the work of excavating an isthmian canal, are in many respects similar to those under which our soldiers were assembled in camps of instruction during the Spanish-American war, with the added dangers due to a tropical environment. If questions relating to water supply and sewerage are postponed until after the laborers are assembled in the localities where the work is to be done, defilement of the camp site and contamination of the local water supplies will almost certainly occur. The ignorance and recklessness with reference to sanitary matters of the average soldier, sailor and laborer have been demonstrated by sad experience; and the inexorable laws of nature will inevitably cause the same disastrous results in the future as in the past, unless we take advantage of the light shed by science upon the cause and prevention of those fatal epidemic diseases which during past centuries have scourged the human race. To ignore the teachings of sanitary science, at the outset of the twentieth century, would be both criminal and disgraceful. In tropical and semi-tropical regions, neglect of sanitary police and contamination of the water supply are the common causes of other infectious maladies which may even exceed typhoid fever in the numbers of their victims. Among these we may mention especially tropical dysentery, chronic diarrhœa, and the disorders due to various intestinal parasites. This whole group of diseases may be avoided if no food or drink is taken which contains the germs or ova which give rise to them.

But how about the so-called "climatic diseases"? Can these be avoided? Certainly they can; for, as a matter of fact, no infectious diseases are directly due to climatic influences, although climate has much to do with the prevalence of some of these diseases when the germs to which they are due are introduced to a given locality. Thus malarial fever and yellow fever prevail only where climatic conditions are favorable for the propagation of the species of mosquitoes by which the parasites to which these diseases are due are transmitted from man to man. Mosquitoes cannot multiply unless they can find water in which to deposit their eggs, and in which their larvæ can thrive. They lose their activity and soon die when exposed to a temperature below the freezing point. Therefore, malarial fever and yellow fever are diseases of tropical and semi-tropical regions, or of the summer months in the temperate zone; and they do not prevail in elevated and arid regions, even in the tropics.

I shall not attempt in this paper to present the evidence which justifies the assertion that malarial fever and yellow fever are contracted through "bites" of mosquitoes. The scientific demonstration that this is a fact is complete, and is accepted by well-informed physicians in all parts of the world. This knowledge has been gained so recently, however, that the public, generally, and many men of science whose studies have been in other fields of investigation, are not fully convinced that their preconceived notions with reference to the etiology of these diseases are wrong. I may say to these persons, in brief, that we know the malarial parasite, which differs somewhat in different types of malarial fever, as well as the ornithologist knows his birds, or the farmer different kinds of grain which he sows. We know the different stages of its development in man and in the bodies of infected mosquitoes; we recognize it in the blood of patients, and unhesitatingly found our diagnosis upon the result of a microscopical examination of such blood. Finally, it has been proved that persons may remain indefinitely in the most intensely malarious regions, such as the Roman Campagna, without contracting malarial fever, if they are protected from the bites of mosquitoes by gauze mosquito-netting. The climate of itself is not only harmless, but salubrious. We may safely say the same of the climate of the Isthmus of Panama. If we can protect the laborers on the isthmian canal from the bites of mosquitoes, they will enjoy an entire immunity from the deadly infectious maladies which have been the scourge of the coast regions of the Caribbean Sea, the Gulf of Mexico, and the West Indies for centuries.

But how is this to be accomplished? A man cannot work under a mosquito bar. No; but he can sleep under one, and he should be compelled to do so when his health is a matter of prime importance to his employer. It has long been known that "exposure to the night air" in malarious regions is especially dangerous, and now we know the reason. Mosquitoes seek their food mostly at night; and man, when not protected by a mosquito bar, is especially exposed to their attacks while he is asleep. That sleeping under a mosquito bar affords a certain amount of protection from attacks of malarial fever, has been repeatedly reported by travellers in tropical regions, but the explanation of this alleged fact is of recent date.

We have recent evidence that a properly conducted war upon the mosquito, and especially upon its breeding places, may lead to notable results in diminishing the numbers of the pestiferous insect. Witness the success obtained by Major Gorgas, Surgeon, U. S. A., during the summer of 1901, in restricting the prevalence of yellow fever in Havana, by making war upon the mosquito, which has been proved by Major Reed and his associates to be the active agent in transmitting this disease from man to man. As another instance of what may be accomplished by intelligent efforts and a reasonable amount of money, I call attention to the work done by Mr. Henry Clay Weeks on Centre Island and its vicinity.*

It has long been known that excavating the soil in so-called "malarious regions" is very likely to be followed by a serious outbreak of malarial fever, or sometimes of yellow fever. This we can now understand. Such excavations lead to the formation of pools of rain-water, which afford the best possible breeding places for mosquitoes. As pointed out by Mr. Weeks, the two principal methods of fighting mosquitoes out-of-doors consist in drainage and the use of petroleum. All pools of standing water are to be done away with by drainage, if possible. If not, the surface is to be covered by a film of petroleum, which quickly destroys the larvæ of the mosquito when they come to the surface to breathe, which is necessary for their existence. What has been undertaken in a small way on Centre Island should be carried out, with all the energy and resources that money and competent supervision can command, along the line of the isthmian canal. Let us remember that we are undertaking this great work at the beginning of the twentieth century, and that the means of preserving the health of those employed are as important for the success of the enterprise as the perfection of the steam ploughs and diamond-pointed drills which will be used.

In the army, we have a well-trained medical corps, every member of which realizes that the preservation of the health of our soldiers is a more important matter, even, than the treatment of the sick and wounded. To aid in this work, we have a body of trained enlisted men—the Hospital Corps—equal to about four per cent. of the enlisted strength of the army. The army of laborers which will be sent to the isthmus will require a sanitary corps having a personnel at least as great in proportion to the number employed as is provided for our army in the Philippines. At the head of this sanitary service, we should have a man fully informed as to the sanitary problems which are to be encountered and the best methods of meeting them, and also of demonstrated executive ability. Under him should be sanitary engineers, expert sanitary inspectors, and a corps of intelligent men employed especially for the sanitary service. He should be given the necessary money and autocratic power for the execution of sanitary measures for the protection of the health of the employees engaged in the construction of the canal. He should also have general direction of the medical service, including the establishment of hospitals at properly located points, the purchase of medical supplies, etc. He should select the medical staff for service at these hospitals and at the various camps or stations where the work is in progress. The physicians at these stations should be required to make frequent inspections of the employees, for the purpose of placing upon sick-report or in hospital any man who has fever or dysentery, or any other symptom indicating that he is unfit to work. Rest, suitable diet, and proper medication will often restore such persons to perfect health in a short time. But if left to their own devices, soldiers and laborers often fail to report for treatment in the early stages of a serious malady, when treatment would be most efficacious, and not only endanger their own chances of recovery, but, in the case of certain infectious diseases, place their comrades in danger.

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* See the *Century Magazine* for July, 1902, p. 424.

It is in this way that epidemics often have their origin. Mild and unrecognized cases of typhoid fever, of yellow fever, or of cholera are more dangerous, from a sanitary point of view, than severe and fatal cases which are promptly recognized and properly cared for. Careful sanitary supervision is therefore essential; it is, moreover, economical in the interest of the canal and of the government which has undertaken to construct it, as well as of those who are engaged in the actual work of excavation.

In the army, for military reasons, the medical department is not given any direct authority for the execution of sanitary measures outside of the general and post hospitals, which are under the direct command of medical officers. The commanding officer of a camp or of a military post is responsible for the execution of necessary measures which may be recommended by the Surgeon-General of the army, or by the surgeon of his command, or which may be required by army regulations and general orders from the War Department. In carrying out these sanitary measures the medical department has only an advisory function. An officer of the line, or of the engineer corps, or of the Quartermaster's department, is detailed, with enlisted men or civilian employees to assist him, to dig the sewer, or lay the water pipes, or drain the swamp, etc.; and the general sanitary police of the post or camp is maintained by a detail of enlisted men, or by a squad of general prisoners under the direction of a "police sergeant," or in some cases by civilian employees engaged for this special service. Whether this method is best for the army has been seriously questioned; and it is contended by some medical officers that better results would be obtained if more authority were given to the medical officers, and they were made responsible for the carrying out of necessary sanitary measures, and not simply for making suitable recommendations. However this may be, there can be no question that the sanitary service on the line of the isthmian canal should be under one head, and that the carrying out of measures for the prevention of disease and the care of the sick should be placed in the hands of a competent "medical director," having an efficient staff and full power to act in accordance with his best judgment for the accomplishment of the desired results.

The cost of such a sanitary service would not be inconsiderable, but it would not be great when considered in connection with the magnitude and importance of the work; and I do not hesitate to affirm that, from an economic point of view, such a sanitary service as I have indicated would greatly reduce the cost of constructing the canal, and would shorten the time required for its completion.

A single epidemic of yellow fever occurring among the employees along the line of the canal, at a time when the work was being actively prosecuted, would, without doubt, be more expensive than the cost of an efficient sanitary service during the entire period of construction.

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